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INFLUENCE OF THE POST SPACE PREPARATION ON THE REST FILLING IN ENDODONTICALLY TREATED TEETH

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Abstract: Endodontic treatment is usually indicated for teeth that are carious, severely damaged or fractured. In such teeth, making a post and a crown is indicated. Although the main purpose of the post is to strengthen the structure of the tooth and the possibility of extending the stump, it is equally important not to introduce reinfection into the canal during operation, but also to prevent the micropermeability of the remaining part of the canal filling. The post space preparation involves the removal of the gutta-percha and cementum from the coronary and middle thirds of the root canal, but it can often do damage to the filling in the apical part of the root canal, which can pull, loosen, or damage. During the tests related to the post space preparations, several parameters were examined in relation to the rest of the canal filling. They refer to: different methods for filling the root canals and materials in endodontic therapy, length of the remaining filling in the apical part, methods and instruments used in the preparation of the root canal, but also the most suitable time, ie the most favorable period for preparation after a definite obturation. Numerous tests have been performed in relation to the indicated parameters, but there are also numerous methods for testing whether the filling remaining in the channel meets the rules for hermetic closure. They can be clinical, laboratory, computer or X-ray. Yet while some rules and doctrines can be drawn, there are still many ambiguities and controversial results.

Keywords: apical sealing, apical microleakage, post space preparation

INTRODUCTION

The goal of endodontic therapy is to eliminate the infection from the root canal and to prevent any further contamination of the endodontic space. The improvement of materials and techniques for the treatment of root canals has led to the preservation of countless teeth that would otherwise have been lost. It is widely accepted and confirmed that the natural tooth is always the best choice in terms of any replacement (1).

Endodontic therapy consists of a series of procedures in which it takes place complete shaping and hermetic sealing of the root canal, which doesn't allow permeability through the filling, either from the side of the periapical tissue, nor by the crown of the tooth. This micro-permeability is one of the main ones factors for failure of dentist therapy. Gaps in the apical part will lead to the formation of a new or persistent existing periapical lesion, while on the coronary side can cause a problem: caries that will occur in the next period, poorly placed restoration or poorly made crown, leaving the tooth too long with temporary restoration, inadequate thickness of the temporary filling or its gradual melting (2).

Therefore, the success of endodontically treated teeth depends not only the good treatment carried out, but also by the way they will be restored (3,4).

Endodontic treatment is most often indicated for teeth that are carious, severely damaged or fractured. It is very often indicated in such teeth making a crown, which requires making a post that is placed in the root canal (5).

The purpose of post space preparation

The post space preparation of the root canal is just as important as well as the final restoration. It is imperative not to go beyond the boundaries of the anatomical space of the root canal, as well as to properly apply all stages on the preparation of the root canal for the placement of the post (6).

Although the main purpose of the post is to strengthen the structure of the tooth and the possibility of extending the stump, it is equally important not to introduce reinfection into the canal during operation, but also to prevent the micro-permeability of the remaining part of the canal filling (7-9).

The post space preparation involves the removal of the gutta-percha and cementum from the coronary and middle thirds of the root canal, but it can often do damage to the filling in the apical part of the root canal, which can pull, loosen, or damage.(10,11). Although micropermeability from the peg may occur as a result of peg loosening or tooth fracture, damage to the apical portion will undoubtedly lead to reinfection of the periapical space (12, 13).

When making a post, one should pay attention to(14):

- 1) the appropriate instrumentation,
- 2) correct orientation according to the position of the root
- 3) appropriate length of the preparation
- 4) shaping inside the canal

Post space processing techniques

The first step in preparing a tooth post is choosing which method to use to remove part of the filling. It can be done with mechanical-rotary instruments, physically heated instruments, chemical solvents or a combination of these methods, and this depends on the type of the former filling and canal condition.

The first tests on whether and how much the apical part of the filling is damaged after the post preparation were made much earlier. As early as 1965 Zeigler (15) uses pesorimers on forty-four teeth that have been filled with one of the three methods: with the technique of a single cone, lateral condensation or with silver posts. Its purpose was to evaluate the effect of rotation of the instrument at different filling modes. In a quarter of the samples received, severe damages of the fillings were seen, regardless of the type of the filling, with the differences between the groups being insignificant.

Later, numerous texts and articles were presented, which refer to canal filling, to the various techniques for preparing the canal space, but still there are no studies that would indicate the effect of the work in the canal on the apical part of the filling and its value (16). Due to the many dilemmas and conflicting results, it is needed to answer the following questions:

- 1) How much of the root canal filling can be removed during preparation of the canal space, without endangering the apical sealing?
- 2) Which canal filling technique is most appropriate when planning the post installation?
- 3) Which methods for removing the canal filling give the least impact on the rest of the filling?
- 4) How long does it take to leave between the root canal filling and the post preparation, in order to reduce the damaging effect?

Numerous studies have been conducted and published over the past decades relating to this issue. But unfortunately, the results are pretty contradictory and no definite conclusions can be drawn from them, either specific suggestions, which would point to the advantage of a particular technique or method for removal of the canal filling, the necessary length for the remainder of the filling and the time when the preparation of the space for post installation should be done.

In several experimental studies (17, 18, 16, 13) examinations were done relating to the quality of the remainder of the filling after different types of materials and obturation methods, as well as about materials related to the post space preparation. Some studies show that the integrity of the remaining filling after removal of filling materials depend on a number of previous factors such as: endodontic filling techniques (19, 20), instruments or methods used for removal (21) or the length of remaining filling in the apical part (21, 22). In most of the published papers or studies, the examiners follow several parameters. However, no concrete conclusion can

be drawn, because they all force a certain way of preparation, which differs from other researchers.

There are still controversies over whether space preparation should be done immediately after canal obturation or after 3-7 days (22-26). There are many studies comparing the pros and cons of immediate and delayed post-space preparation and its effect on apical stability (10,16-18).

Some studies show that the integrity of the remaining filling after removal of filling materials depend on a number of previous factors such as: endodontic filling techniques (19, 20).

But despite numerous researches in almost a century, a mode of operation has not yet been defined which would be the gold standard.

Discussion

Insertions in the root canal can cause damage to a healthy apical periodontium, as evidenced by the work of Saunders (27), who shows significantly more periapical changes in teeth with canal posts than in endodontically treated teeth where there is no post. The reason for the failure of the teeth with posts is probably the disruption of the integrity of the canal filling during their construction. This is confirmed by the results of Matijević et al. (28), according to which in the teeth restored with intracanal post in 17.5% of the cases, no filling in the canal was noticed at all, which was probably completely extracted during the preparation. Teeth restored with intracanal post and composite restoration were extracted much more often than teeth where no post was installed, while such a risk did not exist if a crown was placed on the endodontically treated teeth (29).

During the tests related to the post space preparation, several parameters were examined in relation to the rest of the canal filling:

1) Endodontic filling technique

Adequate filling of the root canal system is a prerequisite for long-term success of endodontic therapy (30). Various materials and techniques have been innovated in the last 50 years. Gutta-percha is commonly used to fill root canals in combination with some of the many cements on the dental market (31). Apart from the technique of filling with a single gutta-percha post, other techniques are often used, such as: vertical condensation, continuous wave compaction, filling with thermoplastic gutta-percha carriers and many others. Of course there is also lateral condensation, which is the gold standard and with which all other techniques are compared (32).

The tests that determine the quality of the obturation are different, but most often refer to the percentage of filling of the root canal and examination of the micropermeability of the filling by various methods.

Examinations regarding the presence of empty spaces are different. Some of them are made in cross sections under different magnifications. Most authors consider the technique with a single gutta-percha to be the weakest, as it is insufficient to meet all the irregularities in the root canal (33). Eren et al. (21) conclude from the results obtained that the best results are obtained when filling with hot horizontal compaction. In contrast, Somma et al. (34) find no difference between hot vertical condensation and one-pin filling. Jarrett et al. (35) determining the percentage of gaps, they consider that the Thermafil and the continuous wave technique after Schilder give the best results (36).

The analysis of the micro-permeability of the channel charges occupies a huge part in the research in the last 20 years. It is tested in many ways: by immersion of the samples in color (37), by the fluid transport method by pressure (38), by bacterial penetration, by the electrometric method, by radioisotopes, spectrophotometry and by the glucose transport model.

Sometimes when two methods are tested, different, often conflicting results are obtained. Thus, according to the results of Gilhooly et al. (39), the radiographic quality of the filling was worse in the thermoplastic gutta-percha compared to the lateral condensation, but according to the test with color penetration, the result was quite the opposite.

In addition to cross-sectional analysis, canal filling is also examined by microcomputer tomography analysis. Such is the work of Iglecias (40), who examines the fullness of the canal after filling with condensation continuous wave and filling with a single gutta-percha pin and finds that the first method is definitely much more successful, but it is much more noticeable in the coronary and middle third.

Because in the post space preparation the filling in the apical third is not removed, and knowing that the shape of the canal in that part is always circular and without irregularities, then perhaps that is why the results relating to the fillings are so contradictory.

2) Length of the remaining filling in the apical part

In prosthetics, it is considered that if the length of the post is 1.5 times greater than the length of the crown, a stable product is obtained, and if that is not feasible, the smallest ratio in the height of the crown and the post should be 1:1. However, in the case of shorter roots, much of the filling in the coronary part should be removed and usually only 1-2 mm of filling remains in the apical part.

Dentists agree that the longer the rest of the filling in the root canal, the safer the sealing of the apical part and the lower the chance of reinfection. Examining the micro-permeability of the remaining canal filling after a 4, 5 or 6 mm post preparation Rahimi et al. (41) indicate that the best filling is obtained with a longer remaining portion, and that the difference between the groups was significant. According to De Cleen et al (23) the length of 3 mm remaining filling is the absolute minimum for safe apical filling, contrary to the findings of Abramovitz et al who consider the length of 3 mm to be unreliable, so the minimum would be 4-5 mm (42).

Metzger (43) believes that all the indicated lengths up to 7 mm are insufficient to make a good seal and that his results are more reliable than the others, because he uses a method by

actively forcing the marker through the root canal. The marker passive method used by other researchers is considered insufficient to obtain accurate data (43).

Wu et al. performed a test with the fluid transport method for micropermeability and found that definitely after the post preparation the remaining 4 mm of the filling is not sufficient to prevent the micropermeability as opposed to the definite full filling before starting the post preparation. However, according to their results, cementing the post with any cement compensates the insufficiency of the quality of the remaining filling (44).

3. Preparation time of the root canal for post installation

The time when the post preparation should be done is also a frequently examined parameter.

It is common to allow a few days for the cement to harden completely and for any transient irritation of the periapical tissue to subside during the endodontic treatment. Dalat and Spångberg (16) believe that if the cement is not hardened enough, the filling can be easily moved. Chen et al. (10) come to the same conclusion. Nagas et al. (17) conclude from their results that no matter which filling technique is used, it is significantly better to postpone the post preparation for seven days after the definitive obturation of the root canal. As cement they use AH plus cement. Bodrumlu uses Resilon in his test and also thinks that delayed preparation is better (45).

However, there are authors who prefer the preparation to be done immediately after filling, with the explanation that in this way it takes less time for the final rehabilitation of the tooth, there is no reopening of the tooth and the possibility of reinfection is less. In addition, at the time of obstruction, the dentist is most familiar with the individual specifics of the root canal system, which helps reduce perforation or other unwanted complications. Thus in the tests of Long (46), Aydemir (25) and Greeca (8), it does not matter whether it will be prepared immediately or delayed after a few days, as the stability of the filling remains the same.

According to Dos Reis-Prado (47) and Padmanabhan et al (48). on the contrary, delayed preparation gives worse results.

4. Methods for removing the canal filling

Many methods and ways of removing the filling are recommended to create space for the space placement: mechanical, chemical, thermal or a combination of these (49). The question is which of these methods will lead to the cleanest space and the best preservation of the remaining filling in the apical third.

The mechanical way to remove the filling is most commonly used and fastest method. It can be done with the many hand or machine tools available on the dental market (most commonly Gates Glidden burs or Peeso files are used), although whole series of machine tools for retreating canals are recommended.

Radeva et al. (50) examine the methods of the post preparation and the impact on the quality of the remaining filling and come to the conclusion that during the preparation the work with slower rotation reduces the risk of damage to the apical filling. Özkurt -Kayahan et al. (51) consider that when the removal is done with Gates Glidden burs if the tooth is filled with the single-cone technique there is damage to the remaining filling.

However, mechanically done preparation has its own risks. First of all, the whole filling can be easily extracted. Furthermore, damage to the cavity walls is possible during the rapid and careless instrumentation and transport of the canal. Zuli et al. (52) examined the canal walls after the post preparation and noticed defects in 39.6% of the cases. The transposition of the canals was examined by Mirceska (53) who came to conclusion that the use of machine tools intended for retreatment (ProTaper Retreatment files) are quite rigid and lead to transposition of the root canal, especially if the canal is curved. Working with Peeso expanders also rises the temperature, which can damage the organic tissue around the tooth root. A rise in temperature of 10°C can damage the alveolar bone and periodontal ligament (54).

The thermal method of removing the filling is successful in fillings that contain a large amount of gutta-percha.

The chemical method of removing the filling is the least commonly used, due to problems with its toxicity and difficulty in handling. Studies show that xylene and orange oil soften gutta-percha better than other solvents, such as eucalyptol, halothane, or chloroform (55).

However, again from the data in the literature, no concrete conclusion can be drawn as to which method of removal is the best. Hiltner (56) compares two thermal methods: a heated flame retardant and an electronically heated lateral actuator and finds that there is no statistically significant difference between the two test groups when a 4 mm gutta-percha is left. Haddix et al. (57) compare the mechanical and thermal way of removing the filling from the canal and come to the conclusion that when working with heated instruments a significantly lower micro-permeability around the filling in the apical third is observed. Grecca (8) uses three methods of post preparation: mechanical (LA Axxess burs (SybronEndo) heated plager or diluent applied through a hand tool and concludes that there is no difference between the tested methods. In straight canals the material is best removed mechanically with Gates Glidden, but in curved canals definitely better results were obtained when mechanical instruments were used in combination with chloroform.

According to research by Anjo et al. (58) The Nd: YAG laser is effective in removing obturated material and is better than conventional methods.

Conclusion

All the results obtained from the realized studies show that the integrity of the filling in the apical third during the post preparation can be easily damaged, thus endangering the success of the endodontic and restorative therapy.

Many factors have been examined that are thought to contribute to more successful filling in the apical third, such as: different types of cements or techniques used to fill root canals, instruments and methods used to remove some of the filling in a post preparation, the length of the remaining filling, the time that is most convenient to do the removal and many other parameters. There are also numerous methods that examine whether the filling that remains in the canal meets the rules for hermetic closure of the apical part. They can be clinical, laboratory, computer or X-ray. Yet while some rules and doctrines can be drawn, there are still many ambiguities and controversial results.

The daily technological development of materials and techniques in modern endodontics can also be a stimulus for new research in the field of restoration of endodontically treated teeth.

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